Ontario. Planning and Development, Dept. of
Report on stream Gonditions of Boyd Creek.

Pamph bdr.

REPORT
on
STREAM CONDITIONS
of
BOYD CREEK

A TRIBUTARY OF THE
GANARASKA RIVER

CONSERVATION BRANCH
DEPARTMENT OF PLANNING AND DEVELOPMENT
Toronto - May 12, 1953

DEPARTMENT OF PLANNING AND DEVELOPMENT

HON. W. K. WARRENDER, Minister
A. H. RICHARDSON, Chief Conservation Engineer

R E P O R T
O N
S T R E A M C O N D I T I O N S
O F
B O Y D C R E E K

Toronto, Ontario

May 12, 1953

LETTER OF TRANSMITTAL

Mr. A. H. Richardson,
Chief Conservation Engineer,
Department of Planning and Development,
863 Bay Street,
Toronto, Ontario.

Dear Sir:

I take pleasure in submitting a report on the Stream Conditions of Boyd Creek.

The field work was carried out from June 1 to August 31, 1947. The technical aspects of the survey were under the direction of Dr. F. P. Ide of the Department of Zoology, University of Toronto, who also analysed and interpreted the biological findings.

Yours very truly,

KENNETH M. MAYALL

Toronto, Ontario
May 12, 1953

TABLE OF CONTENTS

ILLUSTRATIONS

M A P

GRAPHS

Table of Contents (contd.)

TABLES

CHAPTER 1

OBJECTIVES

Little is known concerning the factors affecting the productivity of streams in Southern Ontario. Many rivers and streams are no longer producing any yield of game fish and the productivity of many others appears to have fallen to a low level.

While it is obvious that some aspects of the environment must be altered to improve productivity, the methods of improving streams have not been tested scientifically in Canada. Before extensive experimental development of streams would be justified, there should be an analysis of the factors affecting the present habitat for fish and wildlife. The problem involves the complicated effects of improper land use. The amount of flow, severity of flooding, extent of silting, lack of shade and of sheltering logs and brush in the streams, available bottom fauna and aquatic vegetation, pollution, and the physical and chemical characteristics of the water are the chief factors which would have to be examined in addition to the fish populations. Since many of these factors are affected by the depletion of woodlands and by excessive or improper cropping of pastures and grain fields, the improvement and control of the lands above and adjoining the stream would be essential to the experimental development.

A scientific comparison of the effect of reforestation on the flow and productivity of streams has never been made in Ontario. Such a comparison should provide useful fundamental data both in stream biology and in fields outside that of stream biology, that is, in forestry or other land use.

An exceptional opportunity for such a comparison was provided in 1947 when the lands of a small watershed draini into a tributary of the Ganaraska River were bought by the Ganaraska River Conservation Authority for reforestation purposes.

The following report therefore describes the condition of the stream course and the surrounding country in some detail as it was in the summer of 1947, for comparison with conditions in later years.

The chief attention was directed to examination of the temperature, flow and productivity of the two small streams in the watershed. Of these factors the numbers and variety of fauna produced by the streams may well be the most satisfactory indicator of the condition of the streams since they are greatly affected by the temperature and bottom conditions and by the volume, permanence and kind of water available.

PART OF THE

BOYD CREEK WATERSHED

DURHAM COUNTY, ONTARIO

EXAMINED IN 1947

LEGEND

PERMANENT STREAM		WOODLAND	
INTERMITTENT STREAM		BOULDER CLAY	
SPRING	S	BRIDGMAN SAND	
FLUME		PONTYPOOL SAND	
INSECT CAGE		DUNDONALD SANDY LOAM	
		BOUNDARY OF SOIL TYPE 1947	

CHAPTER 2

DESCRIPTION OF THE AREA

The stream which was examined in detail is the upper part of a small tributary of the Ganaraska River, which drains an area of 360 acres, including parts of Lots 8, 9, 10 and 11 of Concessions VIII and IX of Clarke Township, Durham County, Ontario.

This watershed lies on the southern slope of the easterly end of the Oak Ridges moraine, an area of sandhills and boulder clay forming the high land paralleling the shore of Lake Ontario at a distance of ten to twenty miles. The topography is rough and hummocky, with slopes ranging from 2 to 25 per cent.

1. Soil

The soil of almost all of the watershed is Pontypool Sand. In some of the most severely eroded land the Pontypool Sand has deteriorated to Bridgman Sand. Boulder clay has been uncovered by the erosion in other places. The soils can be summarized, with the chief accompanying vegetation, as follows:

Pontypool Sand, 320 acres (86%) - thin grass cover, chiefly Sheep's Fescue (Festuca ovina) and mullein.

Bridgman Sand, 24 acres (6%) - blow sand, no cover of vegetation.

Eroded boulder clay, 7 acres (1%) - devoid of vegetation except for small areas of poplar.

Muck, 6 acres (1%) - chiefly cedar-elm swamp.

Dundonald sandy loam, 14 acres (4%) - poor grass cover.

2. Water

Two permanent streams flow through the area.

(a) Stream A

The spring source of this stream lies in an open area of Pontypool Sand, at an elevation of 900 feet. The stream traverses a V-shaped boulder clay gully cut to a maximum depth of 35 feet, for a distance of 1,225 feet. The sides of this gully ranged in 1947 from 15 per cent to almost perpendicular

slopes. Vegetation on these slopes was limited to a local area of 150 feet long in the middle of the gully where Balsam Poplar has made a foothold. White sweet clover (Melitotus alba) had established itself in a few places on this clay bank. The floor of the gully was fairly well stabilized with rocks and grass cover, chiefly red fescue and bent grass, along the fringe of the stream.

History of the gully

Information from some of the older residents of the district who knew the property well indicates that there was no gully in this area before 1910, and that the present stream came to the ground surface at a point approximately 1,200 feet downstream from its present source. F. Boyd, a former owner of the land, recalled that at that time wheat and peas were intensively cropped from the area where the gully is now. After a particularly heavy spring freshet in 1910 or 1911 a small gully was started. This gully, left unchecked and aggravated by the excessive run-off caused by the removal of the forest cover and subsequent intensive cropping, cut deeper and further each year, but had no permanent stream in it until about 1922 when the floor of the gully reached the underground spring source. The higher ground elevation in the central region of the gully indicates that it was cut out by other erosive agencies than this stream itself. The young vegetation in the gully bears out its relatively recent formation.

(b) Stream B

Stream B rises in open sandy land and meanders through a five-acre cedar swamp. Three and a half acres of eroded boulder clay, fairly well stabilized with poplars by 1947, drain into the stream. The stream flows for 1,500 feet through a cedar swamp which has a decided filtering effect on its silt load.

3. Land Use

This land was first settled between 1840 and 1850. The foundations of the farmstead, which are still in

evidence, are located on the accompanying map. The entire area, with the exception of the cedar swamp and stream beds, was cultivated intensively. The chief crops were wheat, fall rye and root crops. The farmstead was abandoned in 1911 and since then there has been a gradual retrogression in land use from a cropping system of agriculture to a grazing system and finally to its present abandoned state.

CHAPTER 3

CLIMATE AND STREAM FLOW

1. Climate

Some of the more general climatic data concerning the area are here listed:

*	Mean annual temperature	43° Fahrenheit
*	Mean summer temperature	66° "
*	Mean temperature (February)	17° "
*	Mean temperature (August)	66° "
*	Highest summer temperature (estimated)	102° "
*	Growing season (above 42° mean temperature) April 17 - October 27	193 days
*	Frost-free period	134 days
*	Average total rainfall in three summer months (June, July, August)	9 inches
*	Average rainfall for 6-month period April 1 - October 1	17 inches
†	Mean annual precipitation (including snowfall)	34 inches
†	Mean annual snowfall	59 inches
*	Summer Thornthwaite Precipitation-Evaporation Index (June, July, August)	Approx. 12.5

---

* These items are taken or deduced from data contained in "The Climate of Southern Ontario" by D. F. Putnam and L. G. Chapman, 1938.

† These items are averages of 15 years' measurements (1924-1938) at Orono (7 miles south-west of the area). Two factors affect the climatic relation between these two areas. The first is that Orono is only 6 miles from Lake Ontario, while the area studied is 12 miles from the lake, and hence "circulation weather" may affect one area more than the other. The second is that the tributaries studied are at an altitude of 850-900 feet, while the altitude of the meteorological station at Orono is approximately 500 feet. Orographic effects on air currents from any direction are therefore normally more pronounced at one station than at the other.

2. Temperature

Maximum and minimum thermometers were installed in the streams at stations C1, C3 and C5, and temperature readings were taken at the time at which the "stations" were examined. The weekly mean temperatures at Orono were calculated from the daily readings at the Department of Lands and Forests station at Orono.

3. Stream Flow

Flowmeters numbered F1, F2 and F3 were installed (consisting of wooden channels whose width varied from twenty-four to sixty inches, according to the width of the stream). The sides were approximately six inches high to accommodate the total flow of each stream even in flood conditions. Daily records of the flow were kept for alternate weekly periods. Sharp-crested weirs were installed near F2 and F3 for a further check on the flow. Records were taken every two hours during heavy rainfall. The rate of surface flow in the flumes (estimated with a stop-watch) was multiplied by a factor of .8* to give an approximate mean speed of the water.

A rain gauge was installed late in the season to give accurate data on rainfall in the area for comparison with stream flow. In the following tables the daily rainfall at the nearest recording station (Orono) is also shown.

---

* Based on data from H. W. King: Handbook of Hydraulics. New York. 1939.

TABLE 1

WATER TEMPERATURES IN TWO BRANCHES OF BOYD'S CREEK - JUNE 17-AUGUST 26, 1947
(Degrees Fahrenheit)

Date	Station	No. of Days	Maximum	Average Daily Max.	Average Daily Mean	Average Daily Min.	Minimum	Station
June 17-28	C1	12	57	55.9	51.6	47.3	46	C1
	C3	12	58	55.6	51.4	47.2	46	C3
	C5	0						C5
July 3-11	C1	9	57	55.8	51.9	48.1	47	C1
	C3	9	56.5	54.8	51.4	47.9	47	C3
	C5	8	66.5	63.4	56.8	50.2	48	C5
July 15-24	C1	10	57	55.4	51.9	48.3	47.5	C1
	C3	10	57	54.3	51.2	48.4	47.5	C3
	C5	10	67.5	62.7	57.9	53.4	51.5	C5
July 29 - August 7	C1	10	58	56.7	52.5	48.2	46.5	C1
	C3	10	58	56.5	52.3	48.0	46.5	C3
	C5	10	68.5	65.7	59.2	52.7	49.5	C5
Aug. 12-21	C1	10	58	56.6	52.7	49.3	48.5	C1
	C3	0						C3
	C5	10	71	65.9	60.2	55.3	53.5	C5
Aug. 22-26	C1	6	55	54.0	51.5	48.9	48.5	C1
	C3	0						C3
	C5	6	64	62.9	58.4	53.9	52	C5

TABLE 2

AIR TEMPERATURES AT ORONO,
MAY - SEPTEMBER, 1947

(Degrees Fahrenheit)

Week Ending	Average Maximum (1)	Average Minimum (2)	Mean of (1) and (2)
May 5	59	34	48
May 12	53	33	43
May 19	60	43	52
May 26	65	46	55
June 2	60	39	50
June 9	69	49	59
June 16	70	51	61
June 23	74	47	60
June 30	81	59	70
July 7	75	53	64
July 14	77	60	69
July 21	75	60	68
July 28	73	54	64
Aug. 4	77	52	65
Aug. 11	83	60	72
Aug. 18	84	65	74
Aug. 25	83	66	75
Sept. 1	75	57	66
Sept. 8	80	56	68
Sept. 15	80	62	71

TABLE 3

RAINFALL AND STREAM FLOW

Records of rainfall and stream flow at Boyd's Creek together with rainfall at Orono, from June 25 to August 31, 1947

Date	Rainfall (Inches)		Flow (C.f.s.) to nearest .05 c.f.s.		
	Recorded at Orono	Reported or Recorded at Field Stn.	Time	Flume 1	Flume 2
June 25	.11			.25	1.00
26	.02	Rain 1½ hrs.		.25	.75
27	.11			.30	1.30
28				.20	.85
29				* n.r.	n.r.
30				n.r.	n.r.
July 1				n.r.	n.r.
2				.20	1.00
3		Trace		.40	1.00
4				.20	.85
5	.10	Light rain		.25	.70
6	1.00		11:30 p.m.	.25	.70
			1:30 a.m.	.30	1.30
			3:30 a.m.	.25	.70
7	.05			.25	.70
8	.01			.25	.80
9				.25	.90
10				.20	.75
11				.25	1.00
12	.20			n.r.	n.r.
13				n.r.	n.r.
14	.17			n.r.	n.r.
15	.08	Slight rain		.20	1.00
16				.20	.80
17				.25	.90
18	.34	Slight rain in afternoon		.20	.90
19		Showers		.25	.80
20	.03			.20	.80
21	.04	Heavy rain 1 hour	11:30 p.m.	.25	.80
			9:30 a.m.	.35	.85
			11:30 a.m.	.30	.85
			1:30 p.m.	.25	.85
22	1.03	Heavy rain afternoon and evening		n.r.	n.r.
23				n.r.	n.r.
24				n.r.	n.r.
25				n.r.	n.r.
26	.38			n.r.	n.r.
27	1.78			n.r.	n.r.
28				n.r.	n.r.
29				.25	1.05
30		†		.20	.80
31				.20	.80
Aug. 1				.20	.80
2				.20	.80
3				.20	.80
4				n.r.	n.r.
5				n.r.	n.r.
6				n.r.	n.r.
7				n.r.	n.r.

* n.r. - no record; † Rain gauge installed

TABLE 3: RAINFALL AND STREAM FLOW (CONTINUED)

Date	Rainfall (Inches)		Flow (C.f.s.) to nearest .05 c.f.s.		
	Recorded at Orono	Reported or Recorded at Field Stn.	Time	Flume 1	Flume 2
Aug. 8				n.r.	n.r.
9				n.r.	n.r.
10				n.r.	n.r.
11				n.r.	n.r.
12				.20	.80
13				.20	.80
14				n.r.	n.r.
15	.02	Trace		n.r.	n.r.
16				n.r.	n.r.
17				n.r.	n.r.
18	1.08	Trace		.20	.80
19			1:20 a.m.	3.35	5.55
			3:30 a.m.	.75	1.40
			5:45 a.m.	.50	1.30
			8:00 a.m.	.35	1.25
	1.06	1.42	10:00 a.m.	.35	1.15
			12:00 noon	.35	1.05
			2:00 p.m.	.30	.95
				.25	.95
				.25	.95
				.25	.80
20	.11	.13		.20	.80
21	.04	.07		n.r.	n.r.
22				n.r.	n.r.
23				n.r.	n.r.
24				n.r.	n.r.
25				n.r.	n.r.
26	.11			n.r.	n.r.
27				n.r.	n.r.
28				n.r.	n.r.
29				.20	.80
30				.20	.80
31				.20	.80

CHAPTER 4

STREAM TURBIDITY

The suspended matter in 48 water samples was calculated as a percentage, weight by volume. Unless the amount of silt was prohibitive, 400 millilitres of the sample were filtered through a tared fine sintered crucible, washed with a minimum of water, dried at 110°C. for one hour and reweighed. Where the amount of silt was large, only 100 ml. of the sample were used. The analysis of samples was carried out by the Ontario Research Foundation.

The measurements of stream turbidity will have little significance until they are compared with future measurements made after the stream has been improved.

TABLE 4

STREAM TURBIDITIES
FOR SELECTED DATES AT POINTS ON BOYD'S CREEK

At Stations C1, C2, C3 and C4 on various dates
and at Stations F1, F2 and F3 during and after
the rains of August 18 and 19

Station	Date	Time	Weight of Solids in 100 Millilitres of Sample Expressed as % (Weight by Volume)
C1	June 27	10:00 a.m.	0.055
	June 28	4:00 a.m.	0.016
	July 6	10:00 p.m.	0.035
	July 7	8:00 a.m.	0.007
	July 21	9:30 a.m.	0.221
	July 21	11:30 a.m.	0.009
C2	June 28	9:00 a.m.	0.019
	July 5	1:30 p.m.	0.032
C3	June 27	10;00 a.m.	less than 0.001
	July 6	10:00 p.m.	0.001
	July 7	-	0.001
	July 21	9:30 a.m.	0.0061
	July 21	11:30 a.m.	0.0015
C4	June 27	10:00 a.m.	0.116
	June 28	9:00 a.m.	0.040
	July 5	1:30 p.m.	0.011
	July 6	10:00 a.m.	0.016
	July 7	-	0.015
	July 21	9:30 a.m.	0.048
	July 21	11:30 a.m.	0.007
F1	Aug. 18	1:00 a.m.	1.89
	"	3:30 a.m.	0.31
	"	5:45 a.m.	0.09
	"	8:00 a.m.	0.15
	Aug. 19	10:00 a.m.	0.10
	"	12:00 noon	0.23
	"	2:00 p.m.	0.05
	"	4:00 p.m.	0.06
	"	6:00 p.m.	0.01
F2	Aug. 19	1:00 a.m.	1.03
	"	3:30 a.m.	0.07
	"	5:45 a.m.	0.08
	"	8:00 a.m.	0.27
	"	10:00 a.m.	0.10
	"	12:00 noon	0.085
	"	2:00 p.m.	0.11
	"	4:00 p.m.	0.075
	"	6:00 p.m.	0.095
F3	Aug. 19	1:00 a.m.	0.64
	"	3:30 a.m.	0.09
	"	5:45 a.m.	0.05
	"	8:00 a.m.	0.09
	"	10:00 a.m.	0.08
	"	12:00 noon	0.11
	"	2:00 p.m.	0.13
	"	4:00 p.m.	0.08
	"	6:00 p.m.	0.10

CHAPTER 5

STREAM PRODUCTIVITY

1. Stream Insects

The emerging fauna produced in the stream were collected from cages installed in the rapids at five stations on the stream. The five cages (numbered C1, C2, C3, C4 and C5) were of two sizes; three cages of one square foot and two cages of one square yard (outside measurements). The three small cages were placed in the small streamlets, the larger cages lower down in the main stream. The locations of the first four cages are shown on the accompanying map. The fifth station, C5, was the lowest on the main stream and was at a point below the edge of the map. Photographs were taken of the exact location of each cage.

The cages were standard wire emergence cages to catch emerging insects from one square foot or one square yard of stream bottom. The insects in the emergence cages were collected every twenty-four hours for (as nearly as possible) alternate ten-day periods. The cages were cleaned out twenty-four hours before each collecting period was started.

More than one method of assay might have been used, but for the present purposes the daily collection of emerging insects was the method chosen as giving a more accurate figure of quantity and as a more easily reproducible technique than other methods now in use. This method is described in detail elsewhere (Ide 1940).*

The results are presented in the accompanying tables, for approximate ten-day periods. Where the collecting periods were more or less than ten days (June 16-28, 13 days; July 3-11, 9 days, and August 27-31, 5 days), the results have been expressed as ten-day equivalents.

---

* Ide, F. P. Quantitative Determination of the Insect Fauna of Rapid Water. University of Toronto Studies, Biology 47, Publication Ontario Fish Research Laboratory 59. 1940.

TABLE 5

SUMMARIZED TOTALS OF EMERGING INSECTS FROM FIVE STATIONS ON BOYD'S CREEK AT VARIOUS DATES IN 1947

Group	June 16-28	July 3-11	July 15-24	July 29 - Aug. 7	August 12-21	August 27-31
Cage 1						
Chironomidae	666	549	252	189	108	72
Psychodidae	54	27	9	18	9	18
Empidae	18	36	54	27	18	36
Tipulidae	18	36	9	18	9	
Chloropidae						
Simulidae	18	27	54	270	234	270
Plecoptera						
Trichoptera			27	72	18	
Ephemerida			9	99	18	
Total	774	675	414	693	414	396
Cage 2						
Chironomidae	171	63	27	36	27	
Psychodidae		18	9			
Empidae		18				18
Tipulidae			9			
Chloropidae						
Simulidae	9	9			18	
Plecoptera						
Trichoptera	9	18	36	18	18	36
Ephemerida	27	27			9	18
Total	216	153	81	54	72	72
Cage 3						
Chironomidae	171	252	252	198	171	90
Psychodidae	9			9		
Empidae			18		18	
Tipulidae						
Chloropidae			9		9	18
Simulidae	27	18	45		27	36
Plecoptera	9	9	9			
Trichoptera	9	9	27	36	18	
Ephemerida	153	162	9		9	
Total	378	450	369	243	252	144
Cage 4						
Chironomidae	53	42	16	14	18	8
Psychodidae	9	20	11	5	5	2
Empidae	2	8	2	2	1	2
Tipulidae			3	1	8	
Chloropidae	2		1	1	3	2
Simulidae	2	6	47	92	32	2
Plecoptera			1			3
Trichoptera	1	3	5	12	2	1
Ephemerida	14	16	5	4		
Total	83	95	91	131	69	20
Cage 5						
Chironomidae	55	68	70	39	27	8
Psychodidae	4	2			1	
Empidae	5	8	3	2	4	
Tipulidae		2		4	1	2
Chloropidae	5				1	
Simulidae	3	1	1	9	3	
Plecoptera	4				2	3
Trichoptera	7	16	41	23	26	1
Ephemerida	18	42	42	17	12	
Total	101	139	157	94	77	14

TABLE 6

TOTALS OF ALL EMERGING INSECTS
COLLECTED FROM FIVE STATIONS ON BOYD'S CREEK
DURING SIX COLLECTING PERIODS IN SUMMER, 1947

Group	Cages				
	C1	C2	C3	C4	C5
Chironomidae	1,836	324	1,134	151	267
Psychodidae	135	27	18	52	7
Empidae	189	36	36	17	22
Tipulidae	90	9		12	9
Chloropidae			36	9	6
Simulidae	873	36	153	181	17
Plecoptera			27	4	9
Trichoptera	117	135	99	24	114
Ephemerida	126	81	333	39	131
Total	3,366	648	1,836	489	582

While the periods listed above were not in every case exact ten-day periods, the figures of emerging insects have been adjusted to correspond with periods of ten days. The figures quoted are "per square yard of stream bottom", although the sizes of the cages varied.

Sizes of) C1, C2, C3 - 1 square foot opening
cages) C4, C5 - 1 square yard opening

The Ephemerida, with the exception of _Ephemerella funeralis_ taken at Cage C5 on one occasion, were all of the genus Baetis, with the species _B. vagans_ McD., _B. brunneicolor_ McD., _B. cingulatus_ McD, _B. levitans_ McD., and _B. parvus_ Dodds represented. _B. vagans_ was taken at all stations and was the dominant species. At C1, the highest in the stream, _B. vagans_ and _B. brunneicolor_ were the only species present. Additional species found at the lower cages included _Baetis cingulatus_, _B. levitans_ and _B. parvus_.

Plecoptera were not of frequent occurrence and all were of the family Nemouridae. The scarcity of this group in the collections is mainly because sampling was not begun until nearly the middle of June, by which date many Nemoura had already emerged.

Trichoptera were very scarce at Cages 1-3, but included representatives of the families Philopotamidae, Rhyacophilidae, Hydropsychidae and Limnephilidae. Additional species of the families Hydroptilidae, Leptoceridae, Molannidae and Lepidostomatidae were taken at Cage 5, furthest downstream, and some of these same kinds at Cage 4 also.

Diptera, in general small forms, and particularly of the family Chironomidae, contribute the greatest numbers to the counts. Other Diptera which occurred less frequently were species of the families Simuliidae, Tipulidae, Psychodidae, Empidae and Chloropidae. In the tables the families represented have been treated separately in the case of the Diptera but not in the case of the other orders. This was done mainly to separate the Chironomidae from the less dominant families.

All the insects taken at the cages, with the exception of the Trichoptera, are small individuals. The Baetis measure about a quarter of an inch in length, the Plecoptera about three-eighths of an inch. The Diptera, with the exception of some of the Tipulidae which were present in significant numbers at Cage 5 only, are all small

CHAPTER 6

DISCUSSION

While the most useful deductions concerning the effects of improvements on the environment and life of the stream will come after repeated examinations, there are some points which are already clear.

1. Size of Watershed

The volume of flow from the springs varied so little during the summer that it can only be assumed that the reservoir supplying them is very large. It seems quite possible that the watershed, based on the surface features of the land, is not the sole supplier to the springs, that is, that a larger area both above and underground is involved. It is therefore important for this experiment that the lands outside the defined watershed be kept under forest cover. This situation is fortunately under control, since the watershed is surrounded by reforested land owned by the Ganaraska Conservati Authority.

2. Long-Term Weather Factors

Since volume of flow from springs is in part controlled by the height of the water table and therefore by the precipitation and evaporation of, at least, the previous year, these data for Orono (for the twelve months before the survey) were examined. The monthly precipitation and mean monthly temperatures at Orono are shown on the accompanying graphs along with the averages of these deduced from all the Orono records.

The monthly precipitation from June 1946 to June 1947 was remarkably close to the average. During the course of the survey (June - August 1947) the rainfall was considerably above average, but there was no evidence as to what effect it may have had on the ground water level. The mean temperature also followed closely the average of mean monthly records.

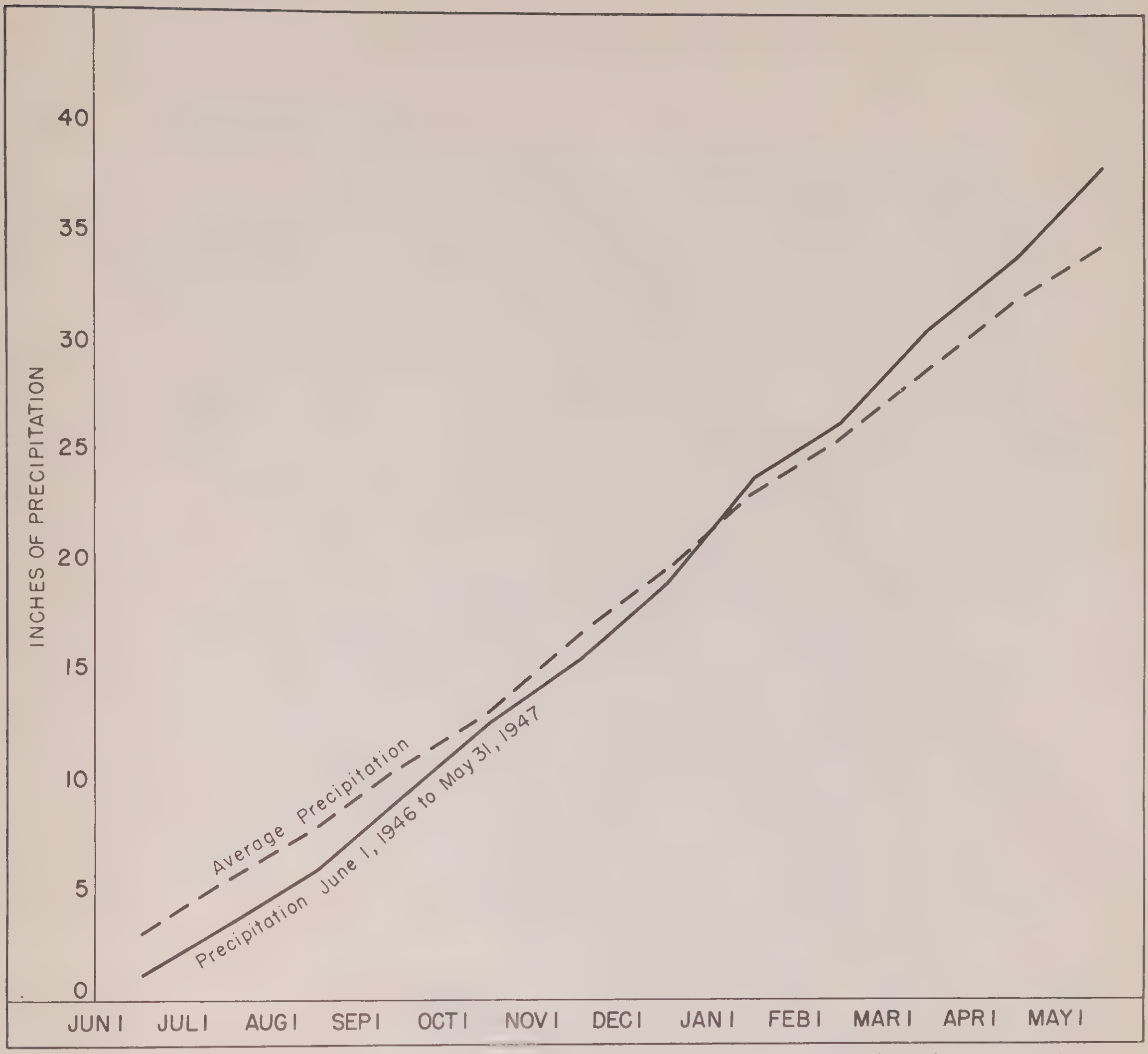


FIGURE 1. Cumulative precipitation by months at Orono, June 1946 to May 1947 inclusive, compared with the monthly average precipitation at Orono.

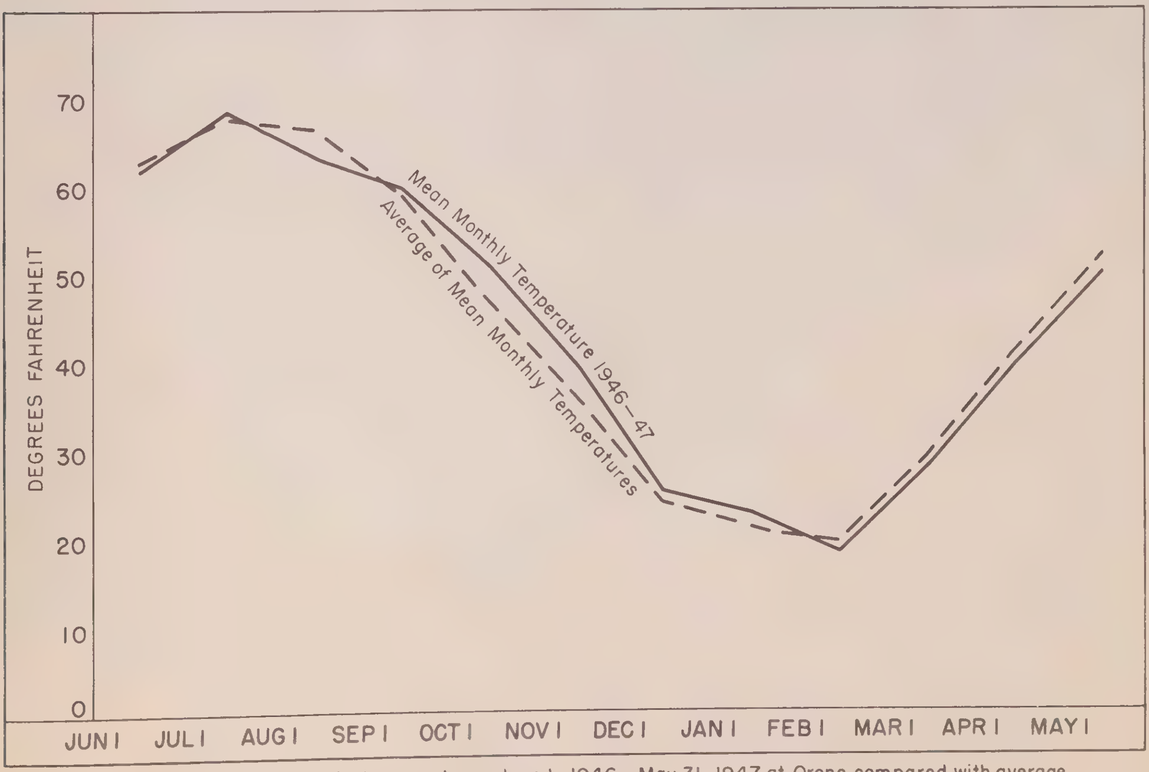


FIGURE 2. Mean monthly temperatures June 1, 1946 – May 31, 1947 at Orono compared with average of all mean monthly temperatures on record at Orono.

PRECIPITATION AND TEMPERATURES AT ORONO

3. Stream Improvement

The stream examined is unusual in both its origin and development. In spite of these facts it was chosen for study because its present condition is typical of many silted streams and because it was known that the whole watershed (apart from the steep sides and bottoms of the gullies) would be reforested in 1947 and 1948. This was done according to plan. Attempts have been made to control erosion in the gullies and at their heads by various means including check dams and the placing of brush. While these methods have had some success, new check dams of improved design are urgently needed. The steep sides of the gullies also require more intensive treatment. When, eventually, satisfactory methods are developed for reducing the amount of silt and clay now contributed to the streams by bank and sheet erosion, it will be necessary to remove the silt now in the bottom of the rapids. Silt removal methods have already been tried in other streams and there is little doubt that this part of the project could be successfully carried out once the stream course is stabilized. From preliminary investigations in other streams it can be expected that the productivity of the stream will then be much increased. The increase may be measured by replication of the survey methods used in the present assay.

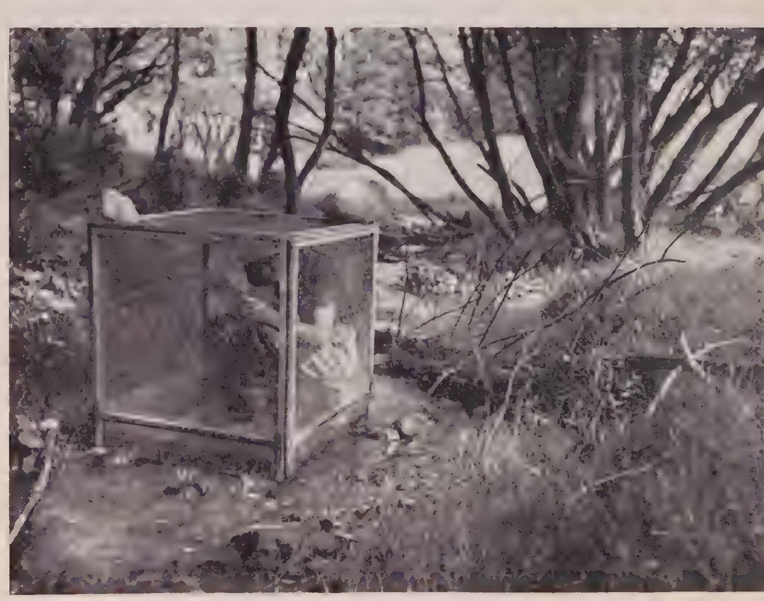
For the purpose of comparisons in future years, stakes were driven into the soil at various points on the watershed and photographs taken of each location. The relationship between the ground cover on the watershed and the flow of the stream is, of course, not ripe for discussion until the effects of reforestation may be apparent. Numerous photographs were taken of the ground cover and other features which may be useful for this comparison.

The source of the westerly stream in 1947.

Most of the watershed had scattered mullein and milkweed growing in a poor grass sod on sand.

Blowsand seen from Stake 7 looking south.

The main gully of the westerly branch of Boyd Creek.



Emergence cage C 4, in the main stream of Boyd Creek. This cage covered an area of one square yard of stream bottom.

A flume (F 3), used for measuring the volume of flow of Boyd Creek.